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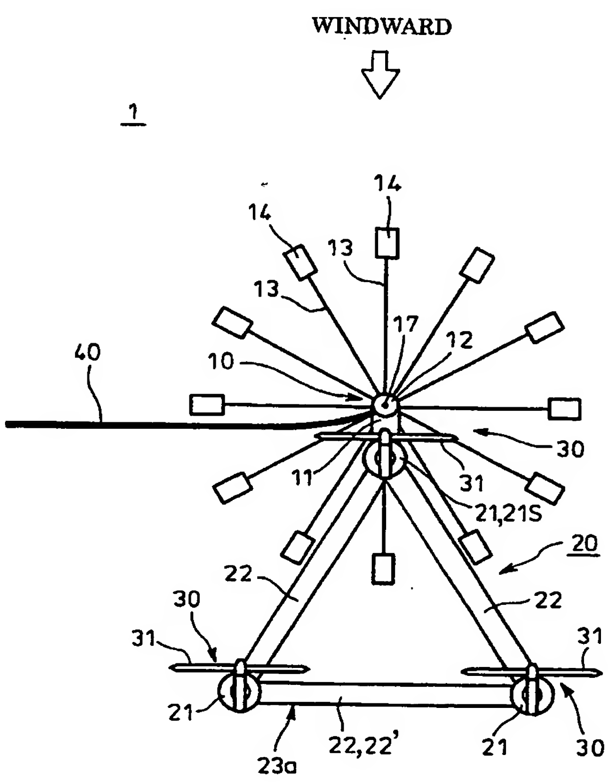
(54) Title: OFFSHORE FLOATING WIND POWER GENERATION PLANT



(57) Abstract: An offshore floating wind power generation plant has a single point mooring system (10) fixed to a sea floor, a float in the form of at least an triangle (23a), the float being floated on a surface of sea and moored at an apex of the triangle to the single point mooring system (10) and a wind power generation unit (30) on the float (10). Effective and stable generation of electricity can be made irrespective of change of the direction of the wind.

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DESCRIPTION

OFFSHORE FLOATING WIND POWER GENERATION PLANT

TECHNICAL FIELD

The present invention relates to an offshore floating wind power generation plant, more specifically, to an offshore floating wind power generation plant which can be stably installed offshore and which allows a plurality of wind power generation units to be rationally disposed thereon, each of the units being able to stably generate electricity with high efficiency.

BACKGROUND ART

Wind power generation plants are attracting much attention as one of eco-friendly applied technologies utilizing natural energy and some of them have already come into practical use and been in operation. It is expected that such plants will be more widely utilized in future.

Various offshore wind power generation plants have been proposed since wind power generation plants installed offshore will receive the wind greater and more stable in speed than those installed on land and

can be expected to generate electricity with higher efficiency.

For example, JP 2000-213451A discloses a wind power generation system in which a tower and a hollow base block are prefabricated in a factory. The base block is installed on a sea floor and is immobilized by a weight therein. Disposed on and fixed to the base block via a connector is the tower on which a wind power generator is installed. Such wind power generation system may be built up offshore or the like in a short period with no adverse affects on the environment, thereby generating electricity.

Further, JP 2000-272581A discloses a wind power generation plant on the water in which a wind power generator in the form of a propeller type windmill is disposed via a column on a structure which is floated on the water by a plurality of floats arranged equidistantly around a periphery of the structure, thereby generating electricity on the structure. When an amount of electricity to be generated is to be increased, a plurality of structures as described above are laterally connected together via connection rods.

Further, JP 11-336653A discloses a wind power generation system movable on the water in which a frame structure is floated on the sea to prevent any damage

by collision or the like and to enhance durability. Floated within and along the frame structure are a plurality of vessels for mounting windmills thereon which are connected to the frame structure. A number of windmills are arranged on each of the vessels and along a circular or polygon line via mounting columns. The vessels connected to the frame structure are connected together via connection rods. The frame structure, which is movable on the sea by propelling means comprising an engine, a screw and a rudder provided on each of the vessels, can utilize through its movement huge and enormous wind energy produced by typhoon or the like. The respective windmills are always directed properly against the wind by automatic directional adjustment and automatic rotational-speed adjustment in response to any variation of wind speed, thereby generating electricity at optimum rotational speed.

The above-mentioned wind power generation system disclosed in JP 2000-213451A, which has the wind power generator on the tower fixed to the base block on the sea floor, may provide more stable installation of the wind power generator in comparison with that of the type floating on the water; however, the installation may become difficult in the case of the sea floor being soft. Moreover, the more the depth of water increases,

the more the tower to be installed is enlarged in size and the installation cost is increased, resulting in extensive limitation with respect to sea areas where the tower can be installed. Therefore, it is unpractical to install such wind power generation system on the ocean with greater depth. Especially when a plurality of towers are to be installed so as to increase an amount of electricity to be generated, there arises a problem of the cost being further increased.

On the other hand, the sea floor may be soft even if the depth of water is seemingly shallow, which makes it instable to dispose the wind power generator on the tower. Then, in order to secure stability of the wind power generator, a larger-scaled support mechanism must be provided by, for example, extending legs of the tower into a layer of hard base rock under the soft sea floor, resulting in increase in the installation cost.

The wind power generation system on the water disclosed in JP 2000-272581A, which has the single wind power generator disposed on the structure floated on the water by the floats arranged equidistantly around the periphery of the structure, tends to be affected by wave motions offshore. In order to suppress a tilting angle, an accelerated velocity and the like of the

structure within allowable ranges for the generator, the scale of the structure and floats needs to be enlarged, resulting in increase in the cost. Furthermore, when a plurality of structures are connected together via connection rods so as to increase an amount of electricity to be generated, all the windmills may be once directed properly against the wind; however, the respective windmills are not always kept to be directed optimally against the wind in response to any change of the direction of the wind. A wind power generator on a windword or front side may be overlapped with a wind power generator on a leeward or rear side in the direction of the wind; in this case, the downwind power generator may be affected by any turbulence due to the upwind power generator, resulting in reduction of the efficiency in generating electricity. Then, in order to minimize any interference of turbulence, distances between the wind power generators need to be increased, resulting in enlargement of the assembly of such structures.

The wind power generation system movable on the water disclosed in JP 11-336653A, which has the windmills arranged together via the columns along the circular or polygon line on each of the vessels within the frame structure, each of the vessels having

automatic directional adjustment and automatic rotational-speed adjustment in response to change of wind speed, may direct all the windmills properly against the wind even in change of the direction of the wind; however, because of the windmills being arranged together along the circular or polygon line, all the windmills cannot receive the wind in optimum condition. More specifically, a wind power generator on a windward or front side may in alignment, in the direction of wind, with a wind power generator on a leeward or rear side, which causes the upwind wind power generator to be affected by any turbulence due to the downwind power generator, resulting in reduction of the efficiency in generating electricity. Then, in order to prevent any interference of turbulence, distances between the windmills need to be increased with a disadvantageous result that the system becomes large-sized.

The invention was made in view of the above-described problems encountered in the conventional technologies and provides an offshore floating wind power generation plant in which a float is moored to a single point mooring system so as to always keep the float in a constant orientation to the wind, the float being of a shape which allows effective arrangement of the wind power generation units thereon so as to

achieve higher efficiency in generating electricity by the wind power generation units, the float being stable in waves, the float being easily expandable to change an amount of electricity to be generated through increase in number of the wind power generation units mounted on the float.

DISCLOSURE OF THE INVENTION

In order to solve the above-mentioned problems, the inventors made extensive studies and researches to find out that, in a conventional offshore wind power generation system or plant, its stability offshore may be attained, for example, by installing a wind power generator on a structure floated on the water by a plurality of floats arranged along a periphery of the structure or by installing windmills along a circular or polygon line on each of vessels for mounting the windmills thereon and that, in a case of a plurality of power generators being provided so as to increase an amount of electricity to be generated, the windmills may be once directed properly against a certain wind direction; however, such arrangement of the windmills may not be necessarily optimum when the wind direction changes. The inventors variously investigated means or measures for solving the problem and completed the

invention.

An object of the invention is to moor a float to a single point mooring system such that the float is always directed at a constant orientation to the wind, whereby a plurality of wind power generating units on the float are always kept at a constant orientation to the wind.

A further object of the invention is to provide a float of a shape which allows rational arrangement of power generating units thereon, thereby attaining compact in size of the float and high efficiency in generating electricity by the respective wind power generation units.

A still further object of the invention is to enhance stability of a float in waves.

A still further object of the invention is to make a float readily expandable to change an amount of electricity to be generated through increase in number of the wind power generation units mounted on the float.

A still further object of the invention is to provide arrangement of wind power generation units so as not to cause any mutual interference of turbulences due to wind power generation units.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic plan view of an offshore floating wind power generation plant according to an embodiment of the invention and shows a fundamental structure with three wind power generation units;

Fig. 2 is a schematic front view of the wind power generation plant shown in Fig. 1 looking from a windward side;

Fig. 3 is a schematic plan view of a modification of the embodiment shown in Fig. 1;

Fig. 4 is an enlarged side view showing an embodiment of a single point mooring system;

Fig. 5 is a side view of a further embodiment of the single point mooring system;

Fig. 6 is a side view of a still further embodiment of the single point mooring system;

Fig. 7 is a schematic plan view of an offshore floating wind power generation plant according to a further embodiment of the invention in which a float is laterally expanded to have five wind power generation units thereon;

Fig. 8 is a schematic front view of the wind power generation plant shown in Fig. 7 looking from the windward side;

Fig. 9 is a schematic plan view of an offshore floating wind power generation plant according to a

still further embodiment of the invention in which a floating structure is laterally expanded to have seven wind power generation units thereon;

Fig. 10 is a schematic plan view of a modification of the embodiment shown in Fig. 7 having connection members in the form of trusses;

Fig. 11 is a schematic plan view of a further embodiment with addition of a wind power generation unit to the embodiment shown in Fig. 1;

Fig. 12 is a side view of the wind power generation plant shown in Fig. 11;

Fig. 13 is a schematic plan view of an offshore floating wind power generation plant according to a still further embodiment of the invention in which a floating structure is expanded laterally and longitudinally to have thirteen wind power generation units thereon; and

Fig. 14 is a side view of the wind power generation plant shown in Fig. 13.

BEST MODE FOR CARRYING OUT THE INVENTION

Embodiments of the invention will be disclosed in detail below with reference to the drawings.

Figs. 1 and 2 show an offshore floating wind power generation plant according to an embodiment of the

invention as a fundamental structure having three wind power generation units thereon. Figs. 1 and 2 are schematic plan and front views, respectively.

The offshore floating wind power generation plant 1 comprises a single point mooring system 10 anchored to an offshore sea floor, a float 20 moored to the mooring system 10 and directed in a constant orientation to the wind and wind power generation units 30 mounted on the float 20 such that any turbulences due to the wind power generation units never interfere with each other.

The float 20 constituting the offshore floating wind power generation plant 1 is semi-submersible to reduce its sectional area crossing the surface of water, thereby suppressing any fluctuation of the float due to wave motions. The float 20 comprises vertical hollow column members 21 crossing and positioned above and below the surface of water and hollow connection members 22 which connect the column members 21 together below the surface of water.

Such float 20 comprising the column and connection members 21 and 22 is basically constructed to provide a triangle 23a by assembling three column members 21 and three connection members 22 together. Fig. 1 shows a case where the connection members 22 of equal length are assembled to provide an equilateral triangle;

alternatively, an isosceles or other triangle may be provided.

The column members 21 may be hollow and circular in cross section; alternatively, they may be hollow and, for example, rectangular or polygonal in cross section for easiness in fabrication. The connection members 22 may be hollow pipes with, for example, circular or rectangular cross section. Each of the column and connection members 21 and 22 may be reinforced as necessary by providing a reinforcing rib or the like therein.

The float 20 may be further reinforced by providing, as shown in Fig. 3, reinforcing members 24 within the triangle 23a of the float 20 which connect the connection members 22 together.

Mounted on each of the above-mentioned three column members 21 is a wind power generation unit 30 comprising a windmill 31 mounted on a mast 7 and directed properly against the wind by a known directional adjustment mechanism.

The float 20 is moored to the single point mooring system 10 floated offshore and anchored to the sea floor. As the mooring system 10, a conventional mooring unit for locking an offshore structure in position may be employed such as a turret mooring unit as shown in Fig. 4; a turret 12 in the form of a turntable is

mounted on a yoke 11 projected outwardly from a column member 21S at an apex of the triangle 23a of the float 20 and is anchored to the sea floor by a plurality of mooring chains 13 and anchors 14 (see Figs. 1-3), thereby providing offshore mooring of the float 20.

More specifically, the yoke 11 is projected forward and horizontally by integrally connecting the same to the column member 21S at the apex of the triangle 23a of the float 20 and is reinforced by a reinforcing arm 15. The yoke 11 is connected via a bearing 16 to the turret 12 such that the float 20 is horizontally rotatable about a mooring point 17 of the turret 12. In this case, a submarine cable 40 is connected via the turret 12 to the float 20.

The single point mooring system 10 is required to merely support a load to the extent that the float 20 is prevented from drifting. Therefore, even if the sea floor may be soft, the offshore floating wind power generation plant 1 can be stably moored in position through the simply constructed single point mooring system 10.

Thus, the single point mooring system 10 may be in the form of a tower 41 with a simple structure and installed on the sea floor as shown in Fig. 5, the float 20 being moored via a single mooring line 43 to a

rotor 42 on the tower 41. Alternatively, as shown in Fig. 6, a buoy 44 may be anchored to the sea floor via a plurality of chains 13 and anchors 14, the float 20 being moored via a single mooring line 43 to the buoy 44. Anyway, different types of single point mooring systems may be employed, providing that the float 20 can be moored to the single mooring point 17. In the cases of Figs. 5 and 6, the submarine cable 40 is connected to the float 20 via either the rotor 42 on the tower 41 or the buoy 44.

The float 20, which has the column member 21S at the apex of the triangle 23a and moored to the single mooring system 10, is horizontally rotatable about the mooring point 17 on the surface of the sea in accordance with the wind direction. The float 20 is stabilized as shown in Fig. 1 such that, against the wind from the windward side, the left and right connection members 22 are positioned bilaterally symmetrically with respect to the mooring point 17 and loads imposed onto the float 20 on the left and right sides are balanced. The three wind power generation units 30 are laterally equidistant as shown in Fig. 2 when viewed from the front or windward side. The dimension of the triangle 23a is predetermined such that the wind power generation units 30 are spaced from

one another so as not to cause any mutual interference of turbulences due to the windmills 31.

In Fig. 1, loads of the wind from a windward side imposed on the respective windmills 31 of the wind power generation units 30 cause the windmills 31 to be respectively directed properly against the wind by the automatic directional adjustment mechanism. On the other hand, the float 20, which has the column member 21S at the apex of the triangle 23a moored to the single point mooring system 10, turns about the mooring point 17 in accordance with the wind direction such that the loads imposed on the float 20 on the left and right sides are balanced; the balanced orientation is maintained even is the wind direction changes. In Fig. 1, the float 20 is made bilaterally symmetrical with respect to the mooring point 17 against the wind while the connection member 22' at the base of the triangle 23a is made perpendicular to the wind direction, which always keeps maximum the lateral distances between the wind power generation units 30 with respect to the wind direction.

With a known float fixed to a predetermined direction through mooring and on which a plurality of windmills are arranged, distances between the windmills in the directions perpendicular to and in parallel with

the wind direction are required to be approximately three and ten times as long as a diameter D of the windmills, respectively, in view of change in the wind direction. On the other hand, the above-described offshore floating wind power generation plant 1, which has the windmills 31 with their relative positions unchanged with respect to the wind direction even when the wind direction changes and which is rationally constructed to arrange the windmills 31 at the apexes of the triangle 23a designed to a size of not causing any interference of turbulences due to the windmills 31, may have the distances between the windmills 31 shortened to two times as long as the diameter D of the windmill. This not only allows the float 20 to become compact in size but also prevents any mutual interference of turbulences due to the windmills 31 so that a maximum efficiency can be always attained in generating electricity.

The float 20, which has the triangle 23a as a fundamental shape and is semi-submersible, is hardly affected by external forces such as wind force, tidal power and wave motions and can be stable offshore. Therefore, efficient wind power generation can be attained offshore where strong wind force is available.

The float 20 changes its direction with a time lag

in response to change of the wind direction; moreover, a directional relationship between the float 20 and the wind may not be always kept constant because of effects by tidal power, wave motions, etc. other than the wind force, which will not, however, lead to reduction of efficiency in generating electricity by the wind power generation units 30 since the windmills 31 are instantly directed properly against the wind by the automatic directional adjustment mechanisms.

Electric power generated by the respective wind power generation units 30 is transmitted to land, etc., via the submarine cable 40 connected to the single point mooring system 10.

In the offshore floating wind power generation plant 1 constructed as described above, assuming that the diameter of the windmills 31 is, say 80 m, then the distance between centers of the two column members 21 connected together via the connection member 22 of the float 20 may be 160 m; and, a diameter of each of the column members 21 and a height of the mast 7 of the wind power generation unit 30 thereon may be, for example, 15 and 60 m, respectively.

With such offshore floating wind power generation plant 1, the float 20 can be moored to the simply structured single point mooring system 10 even on sea

areas with deep water depth and with severe wave conditions, so that drastic expansion in range of installable sea areas can be attained in comparison with a case where a wind power generator is disposed on a tower fixed to a sea floor.

The float 20, which has the wind power generation units 30 disposed at the apexes of the triangle 23a, allows rational arrangement of the wind power generation units 30 thereon to enhance compactness in size of the float 20 and can readily cope with change of an amount of electricity to be generated through increase in number of the wind generation units 30 thereon.

Figs. 7 and 8 show an offshore floating wind power generation plant according to a further embodiment of the invention with the float 20 being laterally expanded for arrangement of five wind power generation units thereon, Figs. 7 and 8 being schematic plan and front views, respectively. Illustrated in this offshore floating wind power generation plant 2 is a case where the fundamental structure of the float 20 in the form of a single triangle 23a as shown in Fig. 1 is laterally expanded.

More specifically, assembled on opposite sides of the single triangle 23a are reversed triangles 23b each

comprising a column member 21 and two connection members 22, the connection members 22' at bases of the triangles 23a and 23b being in parallel with each other. Mounted on each of the five column members 21 is a wind power generation units 30. Also in this case, Fig. 7 shows the triangles 23a and 23b being equilateral triangles; however, the triangles may be isosceles or other triangles by, for example, making the connection members 22' as the bases of the triangles 23a and 23b different in length from the other connection member 22.

Also in the offshore floating wind power generation plant 2 shown in Fig. 7, the float 20 laterally expanded to have five wind power generation units 30 thereon is bilaterally symmetrical with respect to the mooring point 17 so that the float 20 is stabilized against the wind flowing from a windward side as shown in Fig. 7 with loads imposed on the float 20 on the left and right sides being balanced. The five wind power generation units 30 are laterally equidistant as shown in Fig. 8 when viewed from the front or windward side. The dimension of the triangles 23a and 23b is predetermined such that the wind power generation units 30 are spaced from one another so as not to cause any mutual interference of turbulences due to the windmills 31; for instance, such spacing may be predetermined to

be two times as long as the diameter D of the windmills 31.

In comparison with the case of Fig. 1, the offshore floating wind power generation plant 2 shown in Fig. 7 is capable of generating larger amount of electricity; in addition, it has an effect of being further stabilized against lateral wave movements since the float 20 is laterally expanded.

Fig. 9 shows an offshore floating wind power generation plant in accordance with the invention in which the float 20 shown in Fig. 7 is further laterally expanded for addition of two further wind power generation units 30 to totally have the seven wind power generation units 30 thereon. Added laterally oppositely and outwardly of the reversed triangles 23b shown in Fig. 7 are two triangles 23a each comprising a column member 21 and two connection members 22.

In this manner, the number of the wind power generation units 30 on the float may be readily increased by expansively assembling reversed triangles 23b and triangles 23a in an alternate manner laterally oppositely and outwardly of the core triangle 23a with its single column member 21S being moored to the mooring point, which makes it possible to readily cope with any need for an increased amount of electricity to

be generated.

Fig. 10 shows a further embodiment of an offshore floating wind power generation plant in accordance with the invention. This offshore floating wind power generation plant 4 is different from those described above in construction of the float 20 such that connection members 25 for connecting the column members 21 together are in the form of trusses so as to attain weight saving in comparison with the above-mentioned connection members 22 in the form of hollow pipes. Fig. 10 illustrates a case where the float 20 shown in Fig. 7 is composed by the connection members 25 in the form of trusses; of course, this may also applicable to any of the floats 20 in Figs. 1, 3 and 9.

Even in use of the float 20 with such connection members 25 in the form of the trusses for connecting the column members 21 together, obtained are effects and advantages similar to those already described with respect to the offshore floating wind power generation plants 1, 2 and 3.

Figs. 11 and 12 show an offshore floating wind power generation plant 5 in which a further wind power generation unit 30 is added to the structure of the float 20 shown in Fig. 1 having three power generation units 30 on the single triangle 23a to thereby have

totally four wind power generation units. This offshore floating wind power generation plant 5 has an inner column member 46 disposed inside the triangle 23a via inner connection members 45, a wind power generation unit 30 being mounted on the inner column member 46.

In this case, the wind power generation unit 30 on the column member 21S adjacent to the mooring point 17 is in alignment with that on the inner column member 46 in the direction of the wind; therefore, the latter or rearward wind power generation unit 30 on the inner column member 46 is provided with a longer mast 47 on which a windmill 31 is mounted so as to have height increased in comparison with that of the former or forward wind power generation unit 30 on the column member 21S. This provides arrangement of the rearward wind power generation unit 30 being not affected by any turbulence due to the forward wind power generation unit 30. Alternatively, the forward wind power generation unit 30 may have height increased in comparison with that of the rearward wind power generation unit 30, which is however not preferable since the rearward wind power generation unit 30 may be affected by turbulence due to the mast 7 of the forward wind power generation unit 30.

Such provision of the inner column member 46 inside

the triangle 23a and addition of a wind power generation unit 30 on the inner column member 46, as shown in Figs. 11 and 12, may also be applicable to the triangle 23a and the reversed triangle 23b of the floats 20 shown in Figs. 1, 7 and 9.

Figs. 13 and 14 show an offshore floating wind power generation plant 6 in accordance with the invention in which the float 20 shown in Fig. 9 is expanded backward so as to have twelve wind power generation units 30 thereon. This offshore floating wind power generation plant 6 has the float 20 assembled such that a reversed triangle 23b and a triangle 23a are disposed backward of the triangle 23a and the reversed triangle 23b, respectively, for longitudinal succession as well as for lateral expansion. Though the float 20 may be expanded to any size, it is preferable that the float 20 be expanded so as to be bilaterally symmetrical with respect to the column member 21S moored to the single point mooring system 10, i.e., the mooring point 17. Such expansion of the float 20 allows a great number of wind power generation units 30 thereon, thereby extensively increasing an amount of electricity to be generated.

The expanded float 20 as shown in Figs. 13 and 14 has the wind power generation units 30 on the column

members 21 some of which may be positioned in alignment with each other in the direction of the wind. To overcome this, the rearward one of the wind power generation units 30 in alignment with each other has a longer mast 47 on which a windmill 31 is mounted so as to have height higher than the forward wind power generation unit 30. This provides the rearward wind power generation unit 30 being arranged not to be affected by any turbulence due to the forward wind power generation unit 30.

According to any of the offshore floating wind power generation plants 1 through 6 described above in detail, a semi-submersible float is composed in the form of at least one triangle 23a comprising column and connection members 21 and 22, a wind power generation unit 30 being mounted on each of the column members 21 at the apexes of the float 20, one 21S of the column members of the float 20 being moored horizontally rotatably to a single point mooring system 10 anchored to a sea floor. As a result, a plurality of wind power generation units 30 can be rationally disposed on the float 20 at such spacing from one another that any turbulences due to themselves never interfere with each other and the float 20 can be always kept in a constant orientation to the wind, thereby attaining compactness

of the float 20 in size and generation of electricity with high efficiency.

The fact that the float 20 has the column members 21 crossing the water surface and is semi-submersible suppresses fluctuation of the float 20 caused by wave motions and enhances its stability in waves.

The float 20, which has simplified construction with a fundamental structure being the triangle 23a, is excellent in strength and structure and may be easily expanded laterally and longitudinally so as to increase the number of the wind power generation units 30 thereon, thereby readily increasing an amount of electricity to be generated. The expanded float 20, which take the form of trusses in plane, increases its stability as well as its strength.

As to wind power generation units 30 in alignment with each other in the direction of the wind, the rearward one of the power generation units 30 is set to have height higher than the forward one so that former is prevented from being affected by any turbulence due to the latter.

INDUSTRIAL APPLICABILITY

In an offshore floating wind power generation plant with wind power generation units on a float floated

offshore, a float with a triangle as a fundamental structure is moored to a single point mooring system. As a result, float can be kept in a constant orientation to the wind; the wind power generation units can be rationally disposed on the float to generate electricity with high efficiency by the wind power generation units; the float can be kept stable in waves; and the float can be readily expanded to change of an amount of electricity to be generated through increase in number of the wind power generation units.

CLAIMS

1. An offshore floating wind power generation plant characterized in that it comprises a single point mooring system, a float comprising at least an triangle, said float being floated on a surface of sea and moored at an apex of the triangle to the single point mooring system and a wind power generation unit on said float.

2. An offshore floating wind power generation plant according to claim 1, characterized in that a plurality of power generation units are arranged so as not to be mutually affected by any turbulences due to said power generation units.

3. An offshore floating wind power generation plant according to claim 1 or 2, characterized in that the or each power generation unit has an automatic directional adjustment mechanism for properly directing a windmill against the wind.

4. An offshore floating wind power generation plant according to claim 1, characterized in that said float is assembled from semi-submersed column members and connection members for connecting said column members

together to have plane shape in the form of at least a triangle having the column members at their apexes, one of the column members being moored to the single point mooring system.

5. An offshore floating wind power generation plant according to claim 4, characterized in that said float is assembled from three column members and three connection members for connecting said column members together to have a triangle having the column members at their apexes.

6. An offshore floating wind power generation plant according to claim 5, characterized in that the triangle is an equilateral triangle.

7. An offshore floating wind power generation plant according to claim 5, characterized in that the wind power generation unit is mounted on each of the column members of the float which take the form of the triangle.

8. An offshore floating wind power generation plant according to claim 7, characterized in that an inner column member is disposed inside the triangle via inner connection members, a wind power generation unit being mounted on said inner column member, said or rearward wind

power generation unit on the inner column member being in alignment with the forward wind power generation unit on the column member adjacent to the mooring point and being set to have height higher than that of the latter.

9. An offshore floating wind power generation plant according to claim 5, characterized in that said float is assembled from lateral and alternate succession of triangle and reversed triangle each comprising the column members and the connection members for connecting said column members together.

10. An offshore floating wind power generation plant according to claim 9, characterized in that the wind power generation unit is mounted on each of the column members of the float constituted by the triangles and the reversed triangles.

11. An offshore floating wind power generation plant according to claim 9, characterized in that said float is assembled from longitudinal and alternate succession of the triangle and the reversed triangle each comprising the column members and the connection members for connecting said column members together.

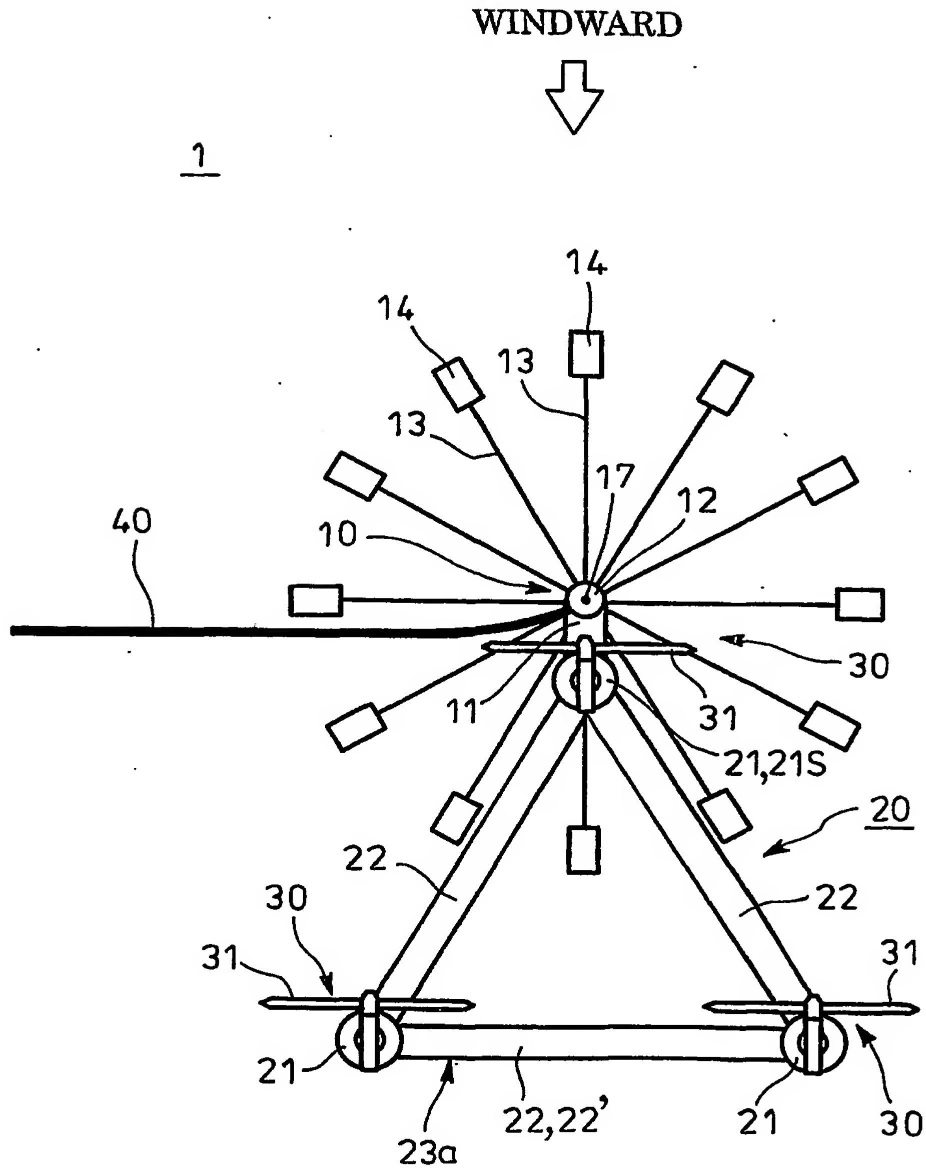
12. An offshore floating wind power generation plant according to claim 11, characterized in that the wind power generation unit is mounted on each of the column members of the float constituted by the triangles and the reversed triangles, any rearward wind power generation unit in alignment with any forward wind power generation unit being set to have height higher than that of the latter.

13. An offshore floating wind power generation plant according to claim 9 or 11, characterized in that one of the column members as apexes of the triangle is moored to the single point mooring system, the float being assembled to be bilaterally symmetrical with respect to the mooring point on the single point mooring system.

14. An offshore floating wind power generation plant according to claim 4, characterized in that the connection members are in the form of hollow pipes.

15. An offshore floating wind power generation plant according to claim 4, characterized in that the connection members are in the form of trusses.

FIG. 1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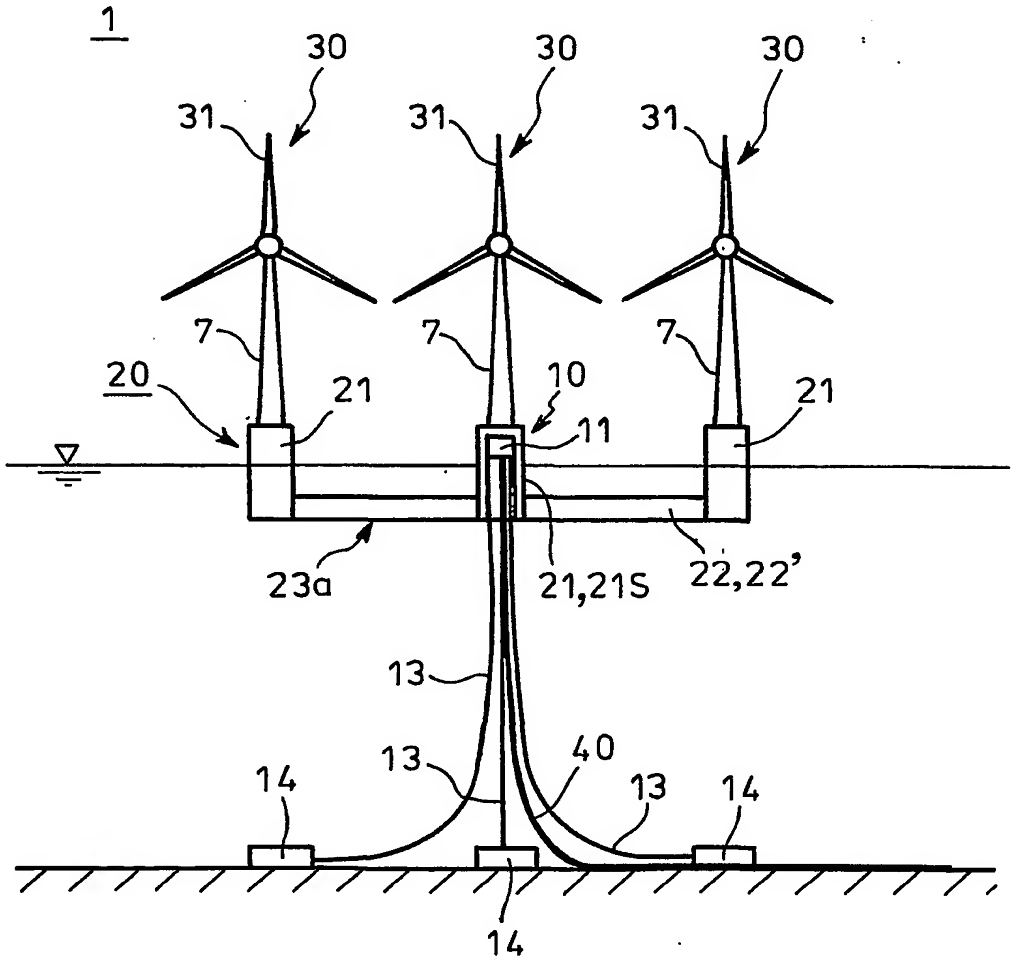
1
14
14
13
13
17
12
40
10
30
11
31
21,21S
20
22
22
30
31
31
21
22,22'
21
30
23a

F I G. 2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30
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30
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7
7
7
20
21
10
11
21
23a
21,21S
22,22'
13
13
40
13
14
14
14
14

F I G. 3

WINDWARD

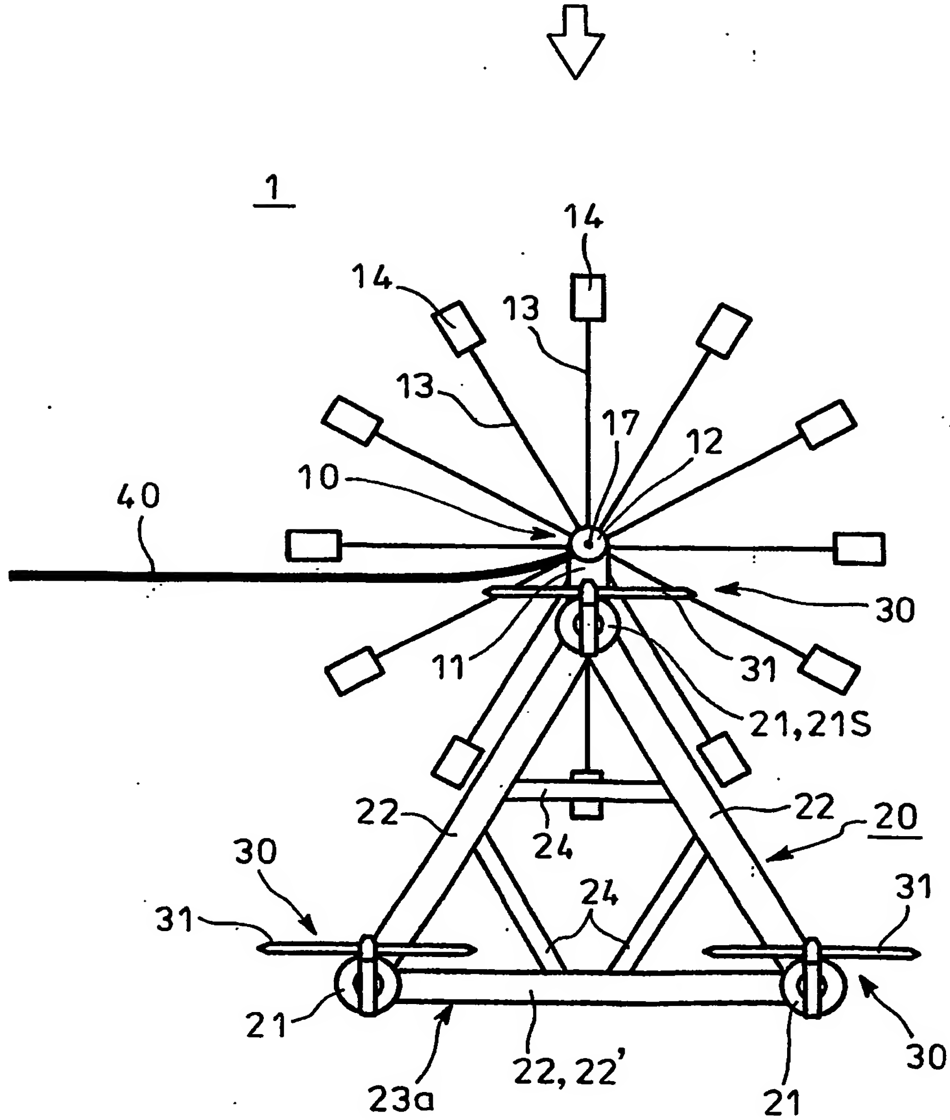


FIG. 4

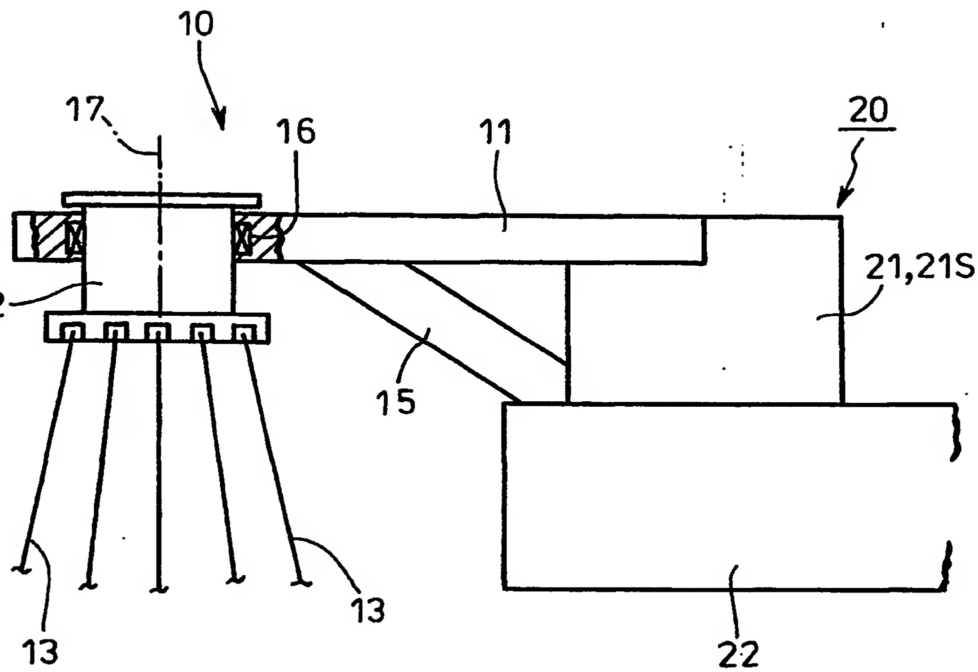
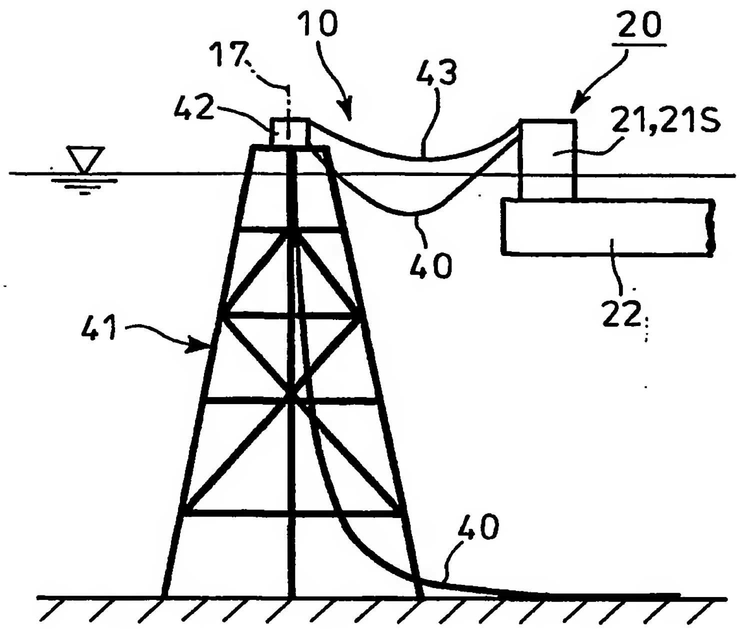


FIG. 5


10
17
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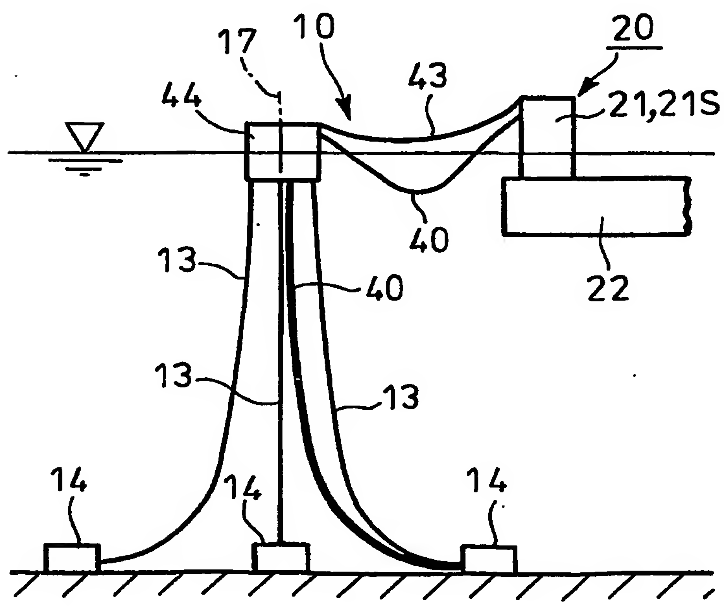
43
42
21,21S
40
22
41
40

FIG. 6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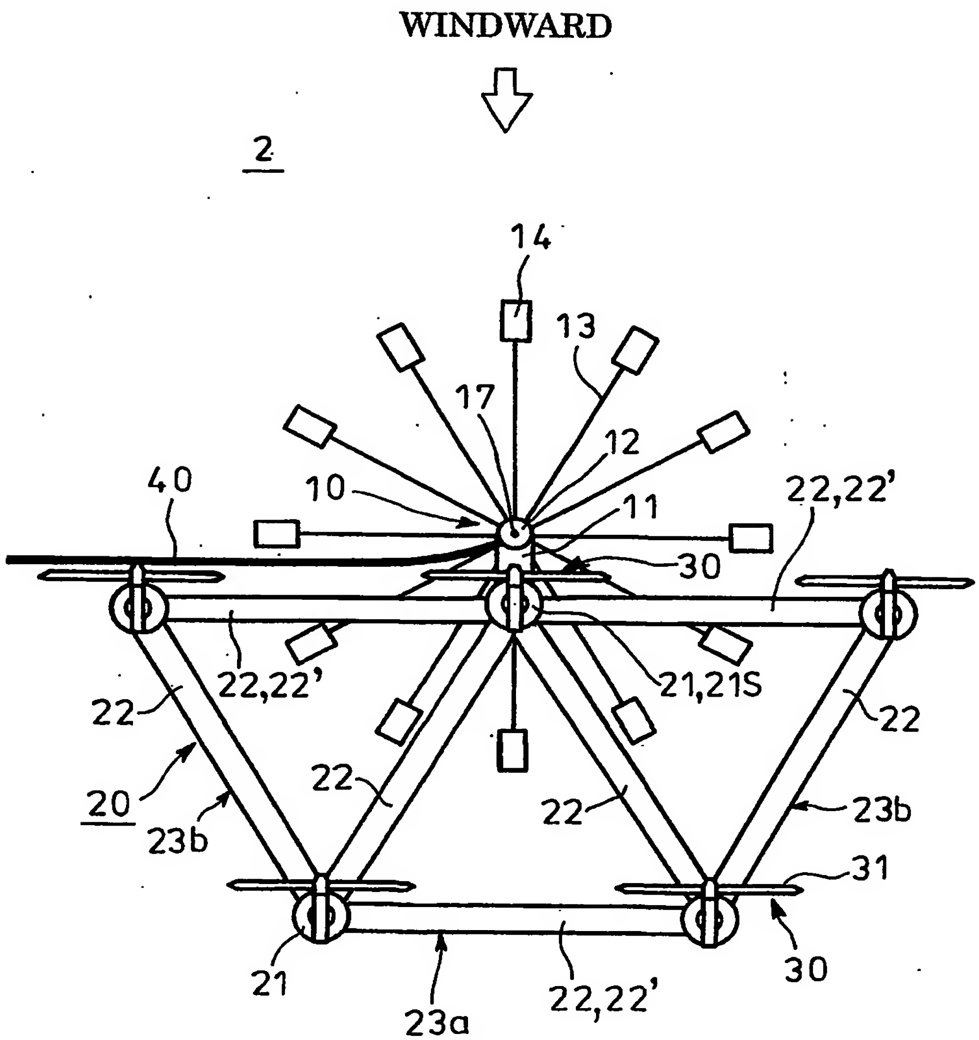
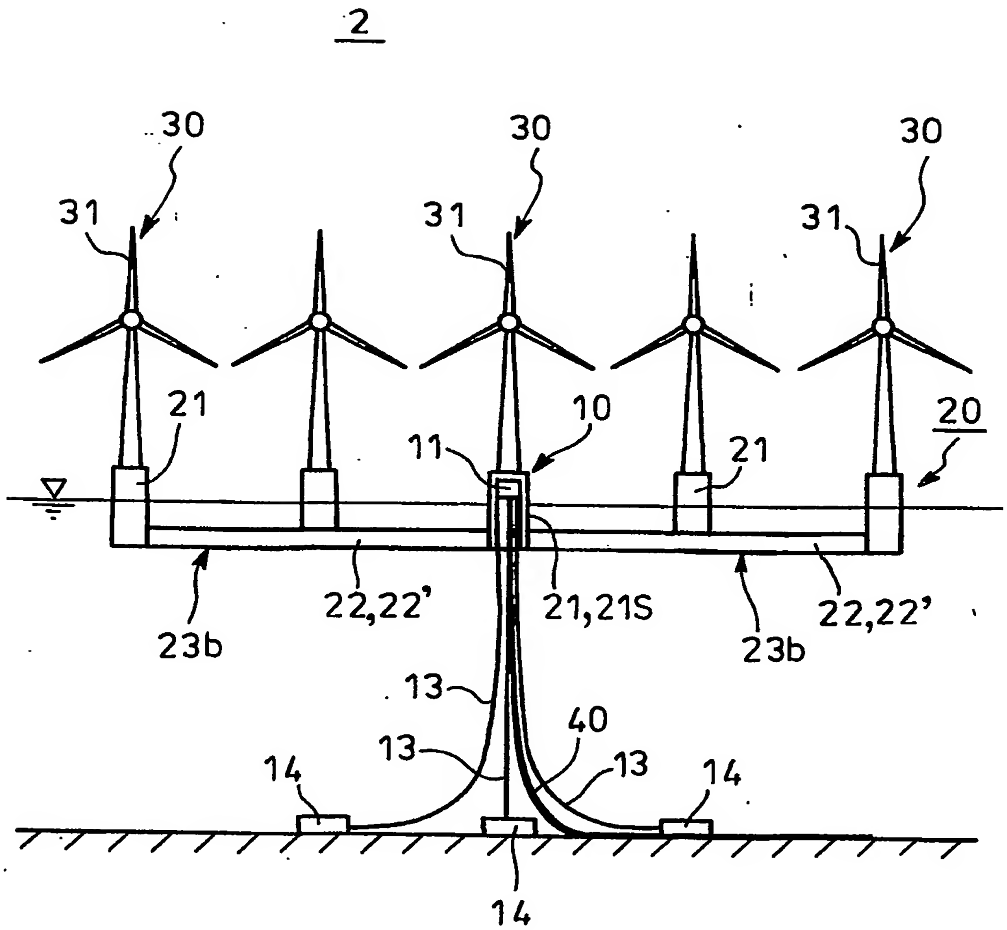
14

F I G. 7


WINDWARD
2
14
13
17
12
40
10
11
22,22'
30
22,22'
21,21S
22
22
20
23b
22
22
23b
31
21
30
23a
22,22'

F I G. 8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11
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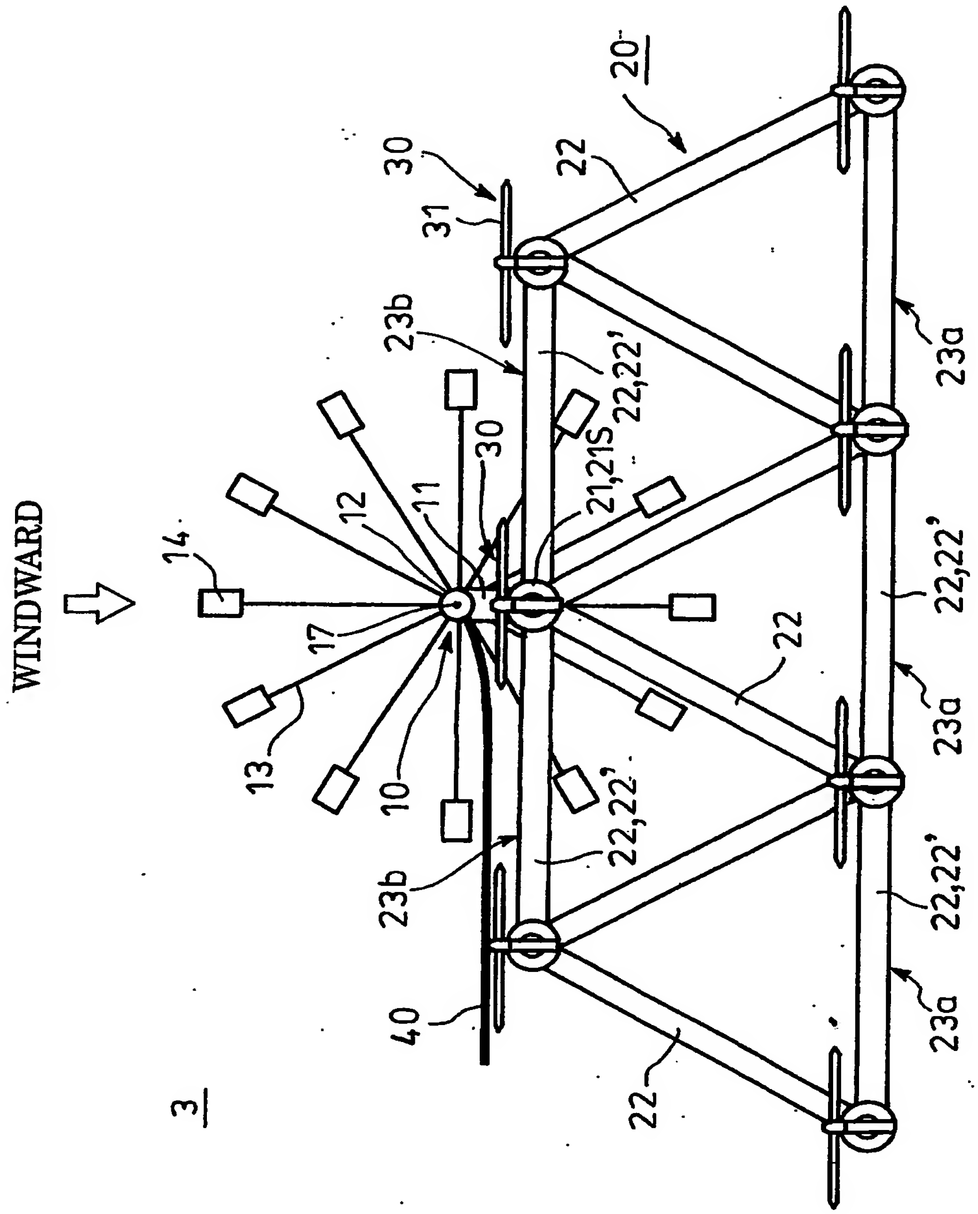
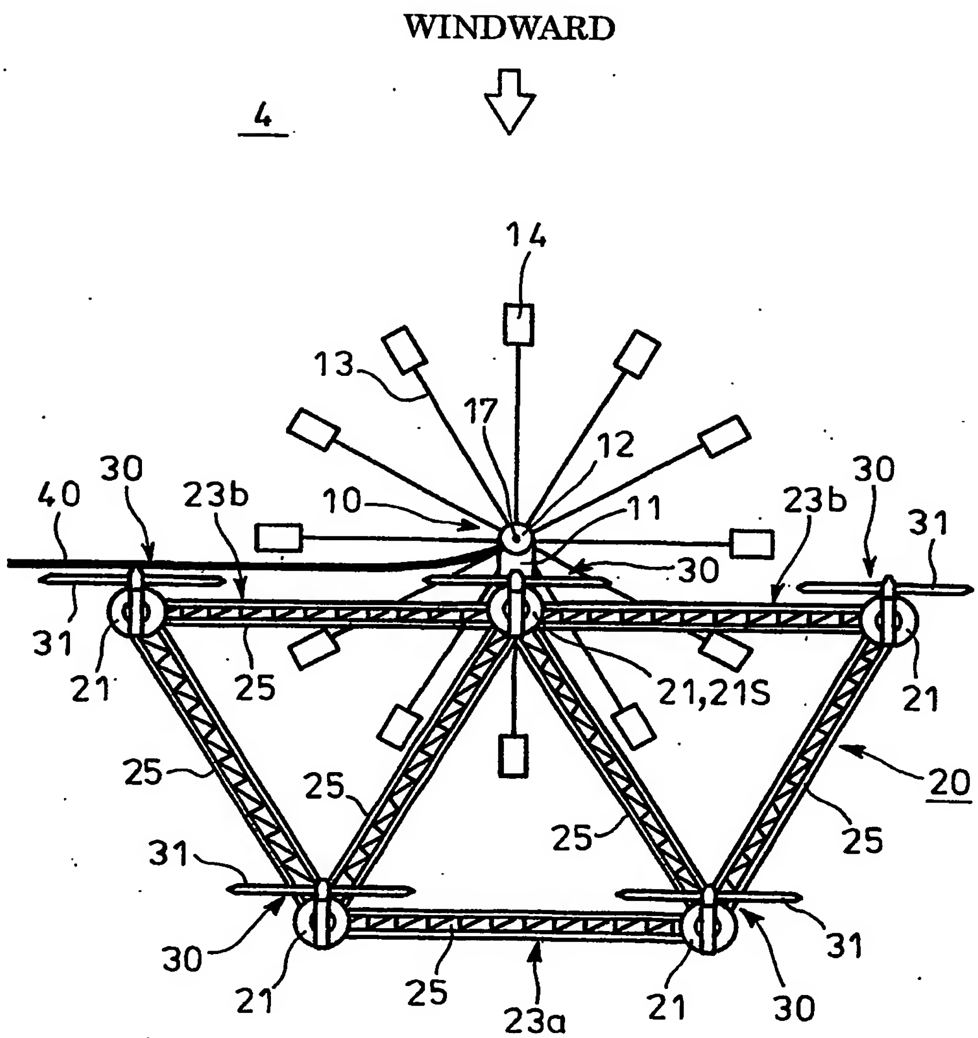
22,22'
21,21S
22,22'
23b
23b
13
40
13
13
14
14
14
14

FIG. 9



F I G. 1 0


WINDWARD
4
14
13
17
12
30
40
23b
10
11
23b
30
31
30
31
21
25
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20
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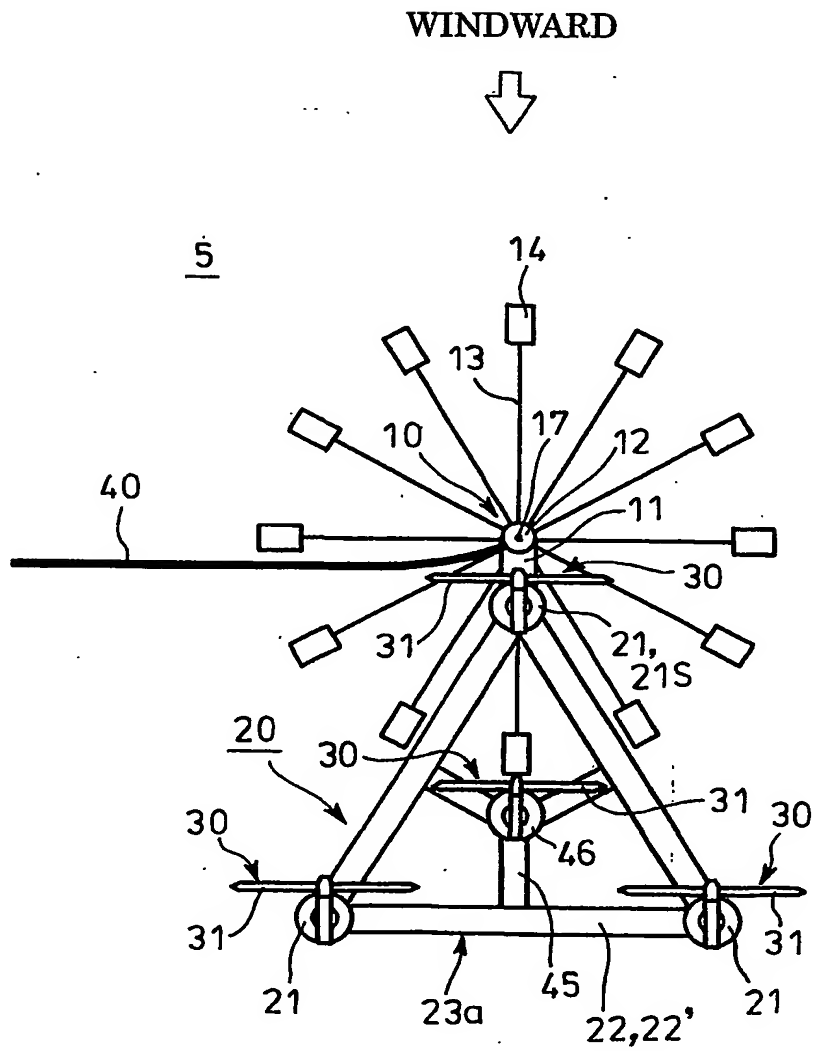
21
25
23a
21
30
31

FIG. 11


WINDWARD
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14
13
17
10
12
11
40
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21,
21S
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30
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46
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31
45
31
21
23a
22,22'
21

F I G. 1 2

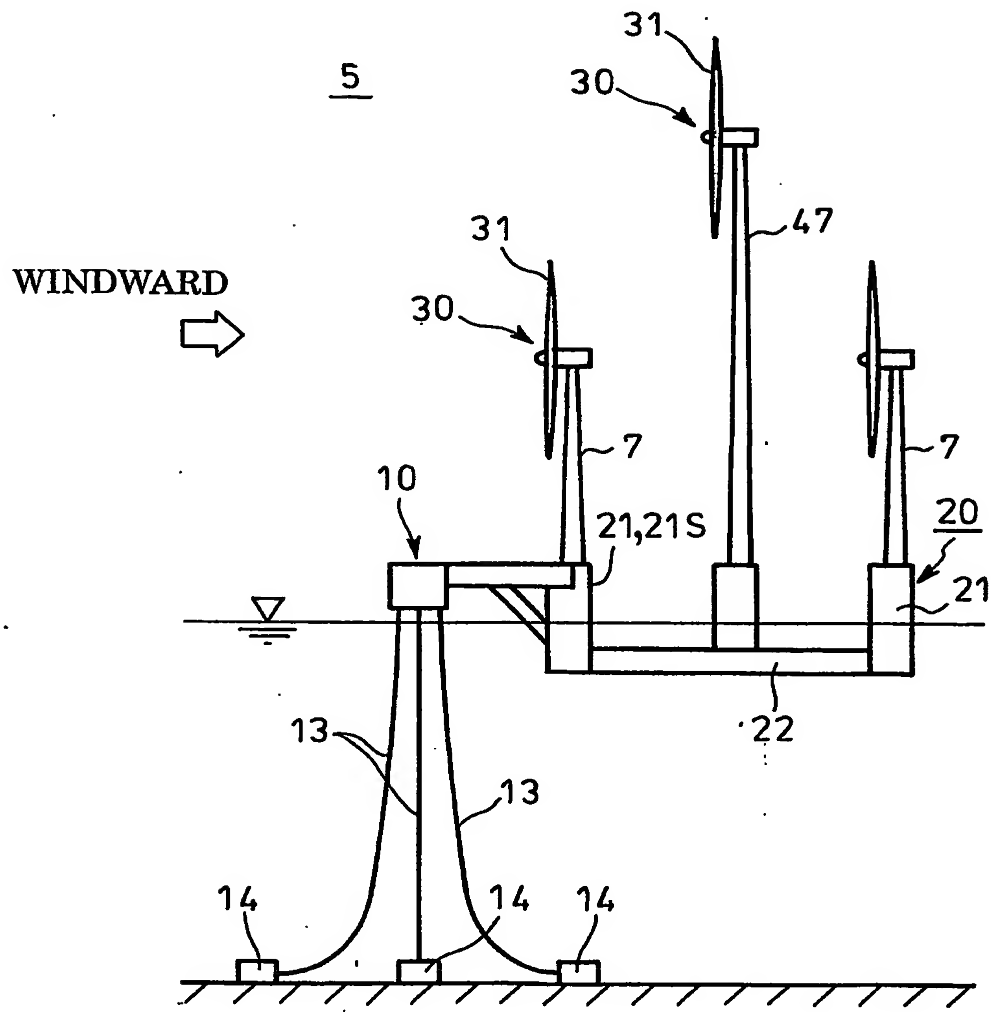


FIG. 13

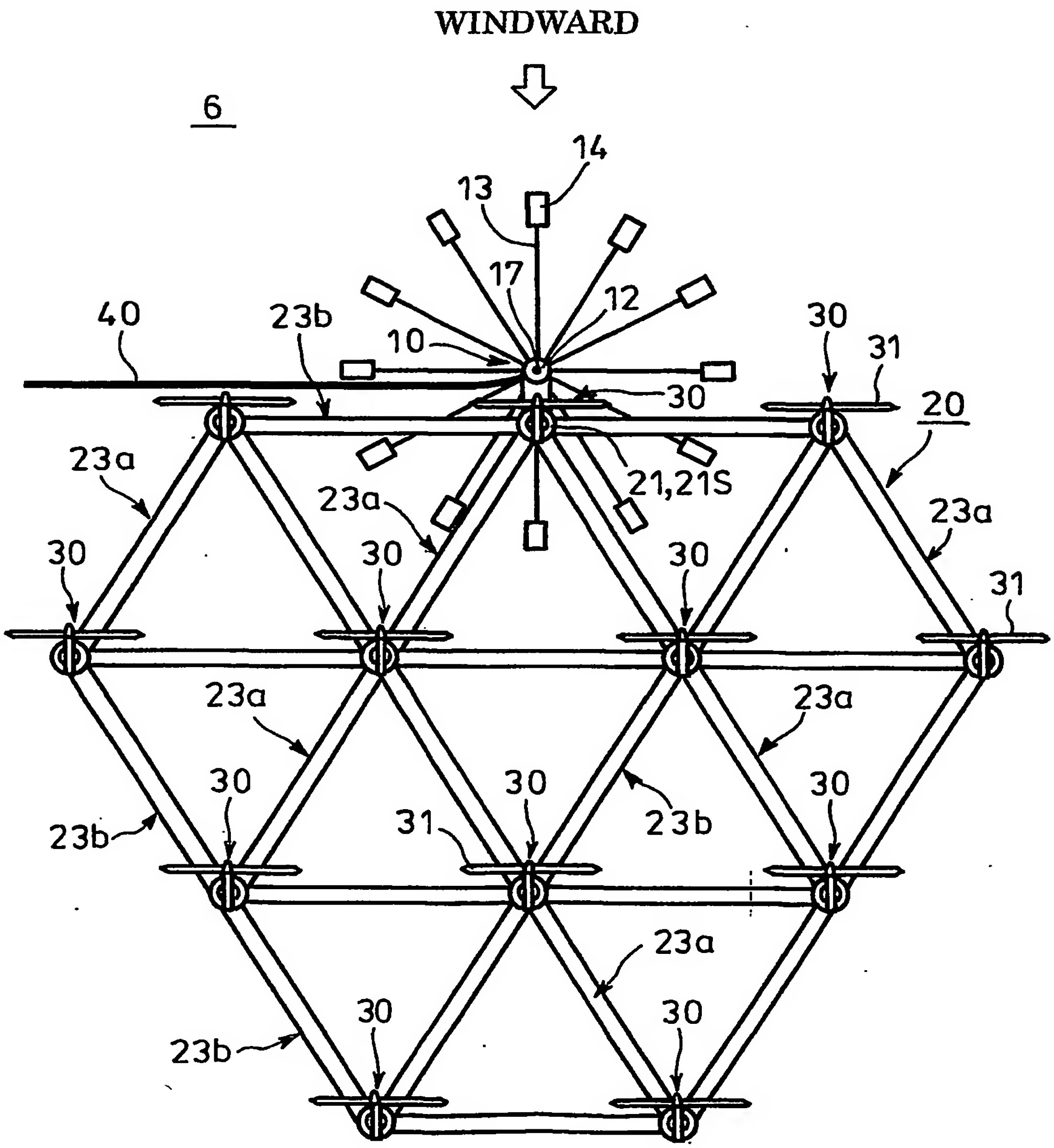
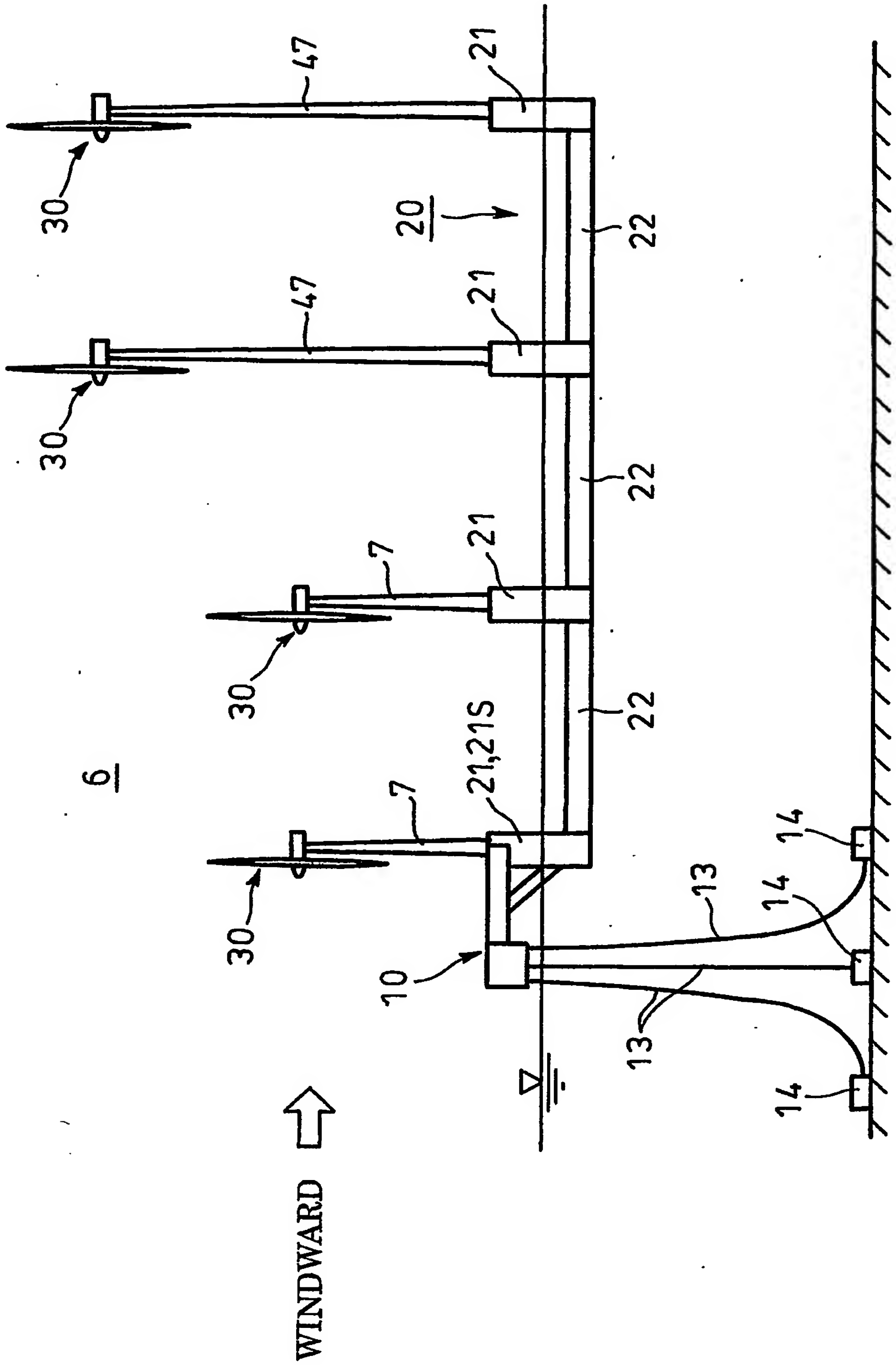


FIG. 14



INTERNATIONAL SEARCH REPORT

Inte al Application No
P(02/02117

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F03D11/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F03D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y Y	DE 299 08 897 U (KUSAN KRISTIAN) 26 August 1999 (1999-08-26) abstract page 3, paragraph 5 page 6, paragraph 2 figures 1-3	1-4,14, 15 5-7 8-13
Y	DE 197 27 330 A (INNOVATIONS UND BILDUNGSZENTRU) 7 January 1999 (1999-01-07) abstract; figures 1-3	5-7
Y	DE 198 46 796 A (GEISLER CHRISTOPH ;RICHERT FRANK (DE); KOLBERT DIETER (DE)) 13 April 2000 (2000-04-13) abstract; figure 6	8

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
22 April 2002	29/04/2002

Name and mailing address of the ISA	Authorized officer
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Inte al Application No
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			EP	1106825 A2	13-06-2001
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